J. Asiat. Soc. Bangladesh, Sci. 43(1): 101-123, June 2017

KNOWLEDGE OF ETHNOMEDICAL PLANTS AND INFORMANT CONSENSUS IN AND AROUND LAWACHARA NATIONAL PARK

MOHAMMAD ZASHIM UDDIN[1], MD. KAMRUL AREFIN, MD. FAKHRUL ALAM, MD. GOLAM KIBRIA, SANKAR LAL PODDER AND MD. ABUL HASSAN
Department of Botany, University of Dhaka, Dhaka-1000, Bangladesh

Abstract

Consensus of the people's healthcare knowledge of ethno-medicinal plants in and around Lawachara national park was conducted from December 2014 to November 2015. The main aim of the study was to record and document plants species used for the treatment of various ailments and to find out level of consensus and agreement between informants regarding uses of plant for particular ailment categories. Data of medicinal uses of plants were recorded through semi-structured interviews, key informant discussions and informal conversations with local and ethnic people including herbal practitioners. A total of 124 medicinal plant species with 245 formularies to treat 53 ailments were recorded. For each species scientific name, local name, family, part used, ailments to be treated and mode of treatment are presented. Leaf is the dominant part used followed by fruit, root and rhizome, whole plant, seed, stem, bark, petiole, bulb, peduncle, latex and flower. In the documented 124 species, herbs were represented by 43%, trees by 31%, shrubs by 15% and climbers by 11% species. Oral consumption is the main mode of treatment in the study area and followed by external application. Maximum formularies were found in the six ailment groups including gastrointestinal complain, diarrhoea and dysentery, fever and cough, dermatitis, jaundice and impotence. According to the local people most of the plants (59%) were harvested from the park vegetation and minimum (41%) harvested from cultivated source. Maximum consensus values (Factor Informants Consensus (Fic) values more than 0.80) were obtained in case of cut and wounds and followed by Jaundice, Respiratory related ailments, Diabetes, Diarrhoea and dysentery, Anthelmintic, Gastrointestinal complain, Impotence, Dermatitis and High blood pressure. *Chromolaena odoratum, Cericoides campanulata, Oroxylum indicum, Cuscuta reflexa, Averrhoa carambola, Cajanus cajan, Justicia adhatoda* and *Citrus aurantifolia* showed 100% Fidelity values (Fl). *Litsea glutinosa, Mikania cordata, Ocimum sanctum* and *Azadirachta indica* were scored maximum Percent of Respondents knowledge values (PRK). It is recommended that species which showed high Fic, Fl and PRK values could be used for further ethno-lead phytochemical analysis to investigate active compounds to discover drugs from plants. Finally, a number of threats to medicinal plants were identified and some measures for conservation are also suggested.

Key words: Consensus, Healthcare, Ethno-medicinal, Lawachara National Park

[1] Corresponding author: zashim01@gmail.com

Introduction

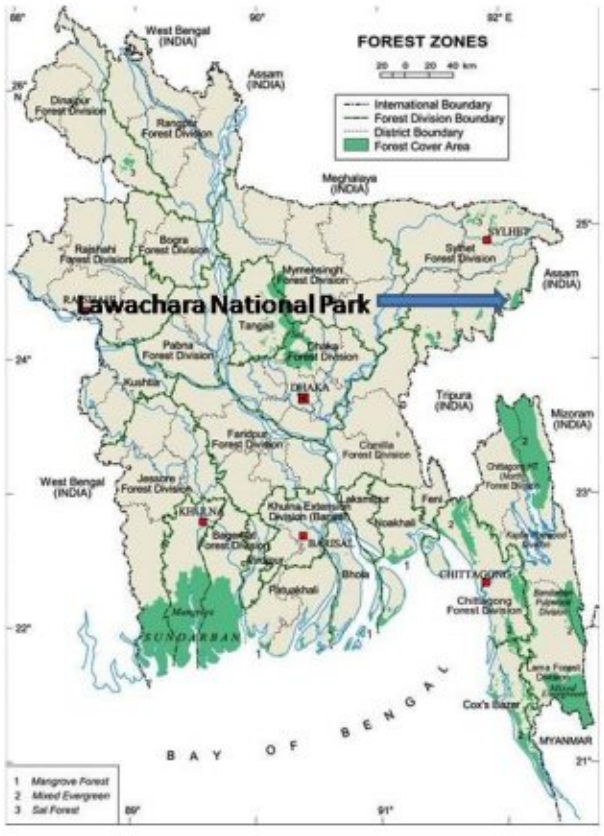
Consensus of the people's in the use of healthcare scientific knowledge of ethno-medicinal plants is the gateway in identifying new plant products of potential and commercial values. It is estimated that there are 250,000 to 500,000 species of plants on Earth (Borris 1999). A relatively small percentage (1 to 10%) of these is used as food by both humans and other animal species. It is possible that even more are used for medicinal purposes (Moerman 1996). Hippocrates (in the late fifth century B.C.) mentioned 300 to 400 medicinal plants (Schultes 1978). In the first century A.D., Dioscorides wrote *De Materia Medica*, a medicinal plant catalog which became the prototype for modern pharmacopoeias. Documented medicinal plants with high degree of consensus can serve as a basis for future investigation of modern drug (Khan *et al*. 2014). Plant based traditional medicine plays a key role in the development of novelties in drug discovery (Wright 2005). Recent studies showed that over 80% rural people of the world rely on herbal medicines (Setzer *et al*. 2006). The world market for herbal medicines based on traditional knowledge is now estimated at US$ 60 billion (Breevot 1998). World leaders met in Rio de Janeiro during 1992 to formulate biodiversity conservation policy including agenda 21 which also gave emphasis on the documentation and sustainable utilization of traditional knowledge of medicinal plants.

Currently, Ethnomedicinal knowledge of plants has been eroding at alarming rate from the nature before proper documentation and evaluation. In order to protect such knowledge, documentation of ethnomedicinal plants has already been started in Bangladesh. A number of articles was published in this field including Mia and Huq (1988), Hassan and Khan (1986, 1996), Alam (1992), Alam *et al.* (1996), Uddin (2006), Uddin *et al.* (2001), Khan *et al.* (2002), Yusuf *et al.* (2002), Uddin *et al.* (2004), Uddin *et al.* (2006), Yusuf *et al.* (2006), Uddin and Roy (2007), Uddin *et al*. (2008), Uddin *et al.* 2012, Haque *et al.* (2014) and Uddin and Hassan (2014). All such articles were listed a good number of medicinal plants of particular community or particular diseases or particular areas of Bangladesh. But there are still more medicinal plants used as sources of herbal drugs by the ethnic and local people of Bangladesh yet to be discovered. Unfortunately no such works have covered the quantitative documentation of ethnomedicinal plants of rural people living in and around Lawachara national park. The park supports a large number of plant species. Among them many species are medicinal those need to be documented and conserved. Local people in and around the park had been using such plants in their primary health care. Currently medicinal plants and traditional knowledge have been eroding due to globalization and climate change. Some of such knowledge is going to eliminate before documentation which is alarming to sustain cultural heritage. In order to save the healthcare knowledge and medicinal plants, in the present study an attempt was made to achieve the following objectives: to record, integrate and document all scattered distribution of traditional healthcare knowledge of medicinal plants; to determine ethno-medically potential and culturally important and

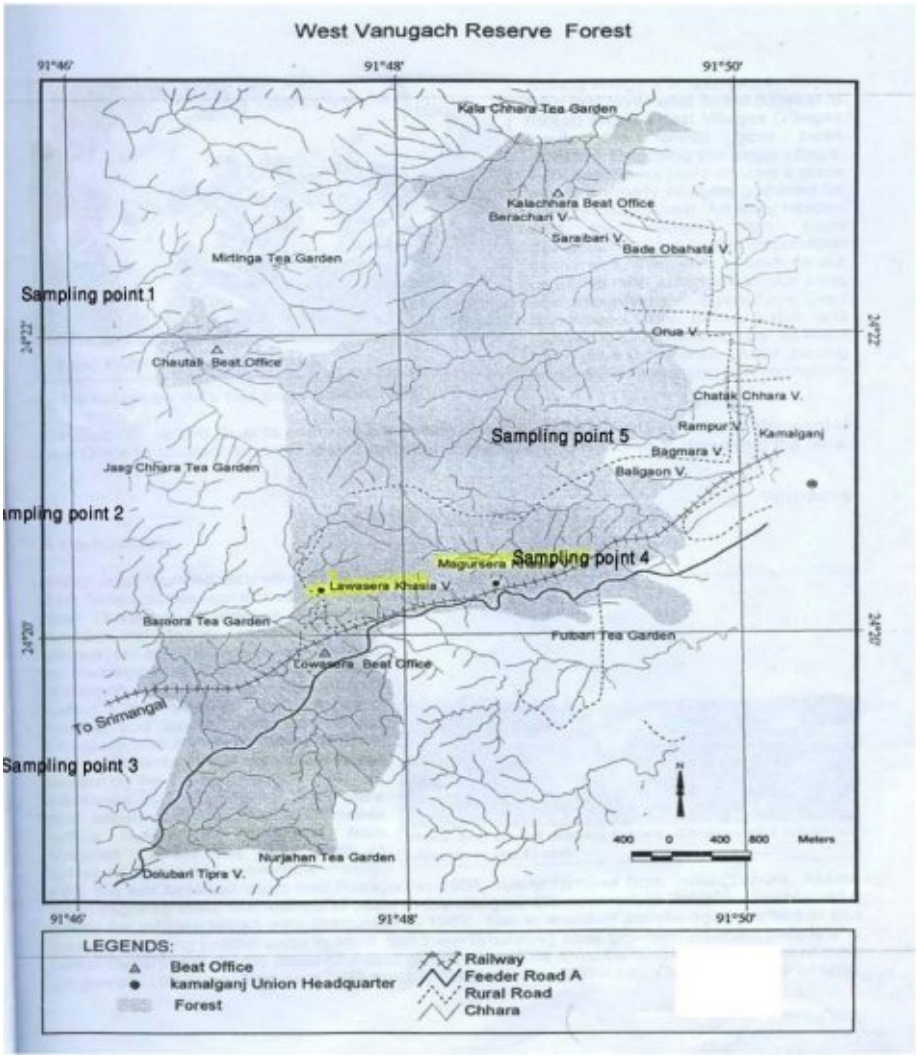
most cited medicinal plants using statistical models; to find out the threats to medicinal plants in the natural habitats and to suggest measures for the conservation

Materials and Methods

Lawachara national park, under Kamalganj upazila of Maulvi Bazar district, is a part of West Bhanugach reserve forest, which was declared reserve in early nineteenth century as per the Forest Act 1878, the Assam Forest Manual 1898 and the Forest Act 1927 (USAID 2006). The park is located nearly 160 km northeast of Dhaka and approximately 60 km south of Sylhet city (Map 1).It lies between 24˚30´-24˚32´ N and 91˚37´-91˚39´ E. The forest was declared as a national Park in 1996 having a total area of 1250 ha and with a plan to extend this area further to include 281 additional ha of the Reserve Forest (Green 1990, Canonizado and Rahman 1998, Riadh 2007 and Ahsan 2007).



Map 1 (a). Bangladesh Map showing Lawachara National Park.



Map 1. (b) Enlarged part showing different sampling points of Lawachara National Park. (Source: Collected from Web).

Present forest types of Lawachara are a combination of planted exotic species and mixed forest with a deciduous canopy and an evergreen understory (Ahsan 2000). The forest originally supported an indigenous vegetation cover of mixed tropical evergreen type (Alam 1998). The topography of Lawachara National Park is undulating, with slopes and hillocks that range from 10 to 50 m in elevation (Rizvi 1970 and Riadh 2007). These hillocks are scattered and interspersed with numerous streams that flow through the forest. The hills are composed of upper tertiary rocks in which sand stone largely

predominates (Ahmad 1970 and Stevens 1986) along with siltstones and mudstones, locally altered to slates and shales. The significant soils in the hills of Maulovi Bazar belong to Ramgarh and Rangamati series on Dupitila formation (Stevens 1986). Soils of the park are generally sandy loam and the rest are mostly clayey loam (Ahmad 1970). The area enjoys a moist tropical climate characterized by a period of high precipitation from April to September and five months of relatively dry period from November to March.

Methods of data collection

The study area has been visited four times in different seasons of the year of 2015 including summer, rain, autumn and winter. Each field trip lasted for five days. The data of medicinal uses were recorded through semi-structured interviews, key informant discussions and informal conversations with local people including herbal practitioners (Alexiades 1996, Chambers 1994 and Martin 1995). A total of 163 informants was interviewed using questionnaire. Among them 117 male and rest 46 are female. Age ranges from 15 to 95 years old. Education levels of the informants were from illiterate up to Bachelor degree. Professionally they were mostly farmer, day labor, house wife, small shopkeepers and medicine men. During the field survey, information on uses of plants to treat human, parts used, mode of preparation and administration was documented. The vernacular names were collected with the help of local people. Voucher specimens for each medicinal plant were collected and processed using standard herbarium techniques (Hyland 1972 and Alexiades 1996). The specimens were identified consulting different Floras viz., Hooker 1872-1897, Prain 1903, Uddin and Hassan 2004, Siddiqui *et al.* 2007c and Ahmed *et al*. 2008a, 2008b, 2009b, 2009c, 2009d and 2009e. Specimens available at Dhaka University Salar Khan Herbarium (DUSH) were consulted in identifying the collected plant specimens. The updated nomenclature of the species followed Siddiqui *et al.* 2007c and Ahmed *et al*. 2008a, 2008b, 2009b, 2009c, 2009d, and 2009e. Voucher specimens are preserved at DUSH.

Factor of informant consensus

In order to estimate use diversity of the medicinal plants and to determine which plants are particularly interesting in the search for bioactive compounds, factor of informant consensus (Fic) was calculate (Trotter and Logan 1986 and Heinrich *et al*. 1998).

Fic is thus calculated applying the following equation: Fic= Nur – Ntaxa/Nur-1

Where Nur is the number of use reports in each category, Ntaxa is the number of species in each category. The relative importance of a species is evaluated by the proportion of

respondents who cited it. The Fic provides a range of 0–1, where high values (close to 1) are obtained when only one or a few plant species are reported to be used by a high proportion of informants to treat a particular ailment. High Fic thus means that there is a narrow well-defined group of species used to cure a particular ailment category and/or that information is exchanged between informants. On the other hand, low Fic values (close to zero) indicate that informants disagree over which plant to use due to random choosing or lack of exchange of information about use among informant.

Fidelity level (Fl)

The Fl value is useful for identifying the informants most preferred species in use for treating certain ailments (Friedman *et al.*1986). the Fl index, $Fl=I_p/I_u \times 100$, where I_p is number of informants who indicate use of a species for the same major ailment, I_u is the total number of informants who mentioned the same plant for any other use. The Fl values range from 0 to 100%. Medicinal plants that are widely used by the local people for certain ailment have higher Fl values those that are less popular.

Percentage of Respondent Knowledge of medicinal plants (PRK%)

PRK values are useful to determine most common medicinal plants in the study area. PRK values of medicinal plants were estimated using the formula: (number of people interviewed citing species/the total number of people interviewed) x100 (Friedman *et al*. 1986).

Results and Discussion

A total of 124 medicinal plants from in and around Lawachara national park for the treatment 53 ailment through 245 formularies was recorded. These species belong to 65 families. For each species scientific name, local name, family, parts used, ailments to be treated, application mode treatment and citation frequency are presented (Table 1). Most cited medicinal plants families in the study area are Rutaceae, Lamiaceae, Mimosaceae, Meliaceae, Combretaceae, and Asteraceae. Diversity in parts used for medicines was recorded in the study area. Leaf is the dominant parts used followed by Fruits, root and rhizome, whole plants, seeds, stem, bark, leaf and bark, petiole, bulb, peduncle, latex and flowers (Fig. 1). Dominant parts used leaf indicated that sustainable used of medicinal plants exist in the study area. In case roots and bark used may promote extinction process of species from nature. Part used fruits and seeds also created problem in natural regeneration of plants, if they do not collect properly.

Table 1. Ethno botanical data on medicinal plants and uses in the study area (S=Shrub, C=Climber, H=Herb, T=Tree)

Scientific name, Voucher number	Local name	Family	Habit	Ailments	Part used	Treatment mode
Abroma augusta (L.) L. f., Z-223	Ulatkombol	Sterculiaceae	s	Impotence	Stem	Juice is taken
Abrus precatorious L., Z-224	Jostimodhu	Fabaceae	c	Cough	Stem	Juice is taken
*Achyranthes aspera*L., Z-88	Upathlenga	Amaranthaceae	h	Jaundice	Leaf	Juice is taken
Acorus calamus L,. Z- 225	Bach	Araceae	h	Appetizer	Rhizome	Cooked rhizome is taken
Justicia adhatoda L.,Z-22	Bashak	Acanthaceae	h	cough	Leaf	Juice is taken
Aegle marmelos (L.) Corr., Z-226	Bel	Rutaceae	t	Dysentery	Green fruits	Raw fruits is taken
				Diarrhoea	Green fruits	Green fruit is taken
				Constipation	Fruits	Pulp is taken
Allium cepa L., Z-227	Peaj	Liliaceae	h	Flue	Bulb	Juice is taken
*Allium sativum*L., Z -228	Roshun	Liliaceae	h	Gastric	Bulb	Juice is taken
				Cold, cough	Bulb	Juice is taken
Alocasia cuculata L., Z- 142	Bishkachu	Araceae	h	Body ache	Rhizome	Cooked rhizome is taken
				Rheumatic pain	Root	Juice is taken
Alocasia macrorrhizos (L.) G. Don, Z-229	Mankachu	Araceae	h	Rheumatic pain	Rhizome	Cooked rhizome is taken
Aloe vera(L.) Burm. f. , Z- 230	Alovera	Aloaceae	h	Impotence	Leaf	Juice is taken
Alstonia scholaris (L.) R. Br., Z-141	Chatim	Apocynaceae	t	Ringworm	Latex	Latex is applied
				Pimple	Latex	Latex is applied
				Dysentery	Bark	Juice is taken
				Diarrhoea	Bark	Juice is taken
				Abscess	Latex	Latex is applied
Alternenthera sessilis (L.) R. Br. Ex Roem. & Schult., Z- 12	Helencha	Amaranthaceae	h	Pox	Leaf	Juice is taken
Amaranthus tricolor L., Z-275	Laoshak	Amaranthaceae	c	Reduced pressure	Leaf	Cooked leaf taken
Amaranthus spinosus L., Z-89	Kanta dugi	Amaranthaceae	h	Urinary problem	Stem	Decoction is taken
				Rheumatic pain	Root	Juice is taken
				Dropsy	Root	Juice is taken
				Diabetes	WP	Cooked plant is taken
Amorphophallus bulbifer (Roxb.) Blume, Z-58	Olkachu	Araceae	h	Rheumatic pain	Rhizome	Cooked rhizome is taken
Andrographis paniculata (Burm. f.) Wall. *ex* Nees., Z- 31	Kalomegh	Acanthaceae	h	Malaria	WP	Juice is taken
				Diabetes	WP	Juice is taken
				Dermatitis	Leaf	Paste is applied
				Anthlemintic	Leaf	Juice is taken
Annona squamosa L., Z-231	Anaros	Annonaceae	h	Anthlemintic	Fruits, root	Juice is taken
Breonia chinensis (Lamk.) Capuron, Z-276	Kadam	Rubiaceae	t	Rheumatic pain	Leaf	Heated leaf is applied
Aphanamixis polystachya(Wall.) R. N. Parker, Z-277	Roina	Meliaceae	t	Dermatitis	Leaf	Tablet is taken
Aristolochia indica L., Z-278	Ishwarmul	Orchidaceae	c	Dysentery	Root	Juice is taken
Asparagus racemosus Willd., Z-279	Shatamuli	Liliaceae	c	Impotence	Root	Juice is taken
*Averrhoa carambola*L., Z-132	Kamranga	Averrhoaceae	t	Jaundice	Fruits	Fruit is taken

Contd.

Scientific name, Voucher number	Local name	Family	Habit	Ailments	Part used	Treatment mode
Azadirachta indica A. Juss., Z-38	Neem	Meliaceae	t	Toothache	Leaf	Decoction used for Gargling
				Malaria	Leaf	Tablet is taken
				Gastric	leaf	Juice is taken
				Fever	Leaf	Juice is taken
				Diabetes	Leaf	Juice is taken
				Dermatitis	Leaf	Paste is applied
				Anthlemintic	Leaf	Tablet is taken
				Pox	Leaf	Paste is applied
Baccaurea ramiflora Lour., Z- 117	Bhubi	Euphorbiaceae	t	Appetizer	Fruits	Fruit is taken
Bambusa tulda Roxb., Z-171	Bamboo	Poaceae	s	Impotence	stem	Cooked stem taken
				Cut	Stem	Powder is applied
Bauhinia acuminata L., Z- 248	Shetkanson	Ceasalpiniaceae	t	Tears of Eye	Leaf	Juice is applied
Blumea lacera (Burm. f.) DC, Z-70	Shialmutra	Asteraceae	h	Diarrhoea	Leaf	Fried leaf is taken
*Bombax ceiba*L., Z-107	Shimul	Bombacaceae	t	Impotence	Root	Juice is taken
Bulbophyllum lilacinum Ridl., Z-247	Ishwarmul	Orchidaceae	h	Impotence	leaf	Juice is taken
				Dysentery,	leaf	Juice is taken
				Diabetes	leaf	Juice is taken
				Heart pain	leaf	Juice is taken
Bursera serrata Wall.*ex* colebr., Z-246	Neur	Burseraceae	t	Appetizer	Fruits	Fruit is taken
Cajanus cajan (L.) Millsp.,Z-245	Orhor	Fabaceae	s	Jaundice	Leaf	Juice is taken
Calotropis procera (Ait.) R. Br.,Z-04	Akanda	Asclepiadaceae	s	Ringworm	Leaf	Paste is applied
				Rheumatic pain	Leaf	Heated leaf is applied
Canabis sativa L., Z-249	Gaza	Malvaceae	s	Reduced pressure	Leaf	Juice is taken
Carica papaya L., Z- 17	Pepe	Caricaceae	s	Stomach ache	Fruits	Cooked fruit is taken
				Jaundice	Fruits	Cooked fruit is taken
				Gastric	Fruits	Cooked fruit is taken
Careya arborea Roxb., Z-244	Bidipata	Lecythidaceae	t	Dysentery	Leaf	Juice is taken
Cassia alata L., Z-250	Daudgash	Caesalpiniaceae	s	Ringworm	Leaf	Juice is applied
Cassinopsis ilicifolia (Hochst.) Sleumer., Z- 100	Kantalebu	Rutaceae	s	Fever	Fruits	Juice is taken
Centella asiatica (L.) Urban, Z- 52	Tunimakuni	Apiaceae	h	Urinary problem	WP	Cooked plant is taken
				Jaundice	Wp	Juice is taken
				Gastric	WP	Cooked plant is taken
				Dysentery	WP	Paste is taken
				Diarrhoea	WP	Cooked plant is taken
				Cataract eye	Leaf	Juice is applied
				Brain tonic	WP	Juice is taken
Ceriscoides campanulata (Roxb.) Tirveng., Z-239	Behlom	Rubiaceae	s	Jaundice	Fruits	Cooked fruit is taken

Contd.

Scientific name, Voucher number	Local name	Family	Habit	Ailments	Part used	Treatment mode
Phyllanthus acidus (L.) Merr., Z-251	Leboi	Euphorbiaceae	t	Fever	Fruits	Fruit is taken
Citrus aurantifolia (Christm. & Panzer) Swingle, Z- 40	Lebu	Rutaceae	s	Jaundice	Fruits	Juice is taken
Clerodendrum viscosum Pers., Z-238	Bhait	Verbenaceae	h	Stomach ache	Leaf	Juice is taken
				Dysentery	Leaf	Juice is taken
				Cut	Leaf	Juice is applied
				Cough	Leaf	Juice is taken
				Anthlemintic	Leaf	Juice is taken
Coccinia cordifolia Congn., Z- 13	Telakucha	Cucurbitaceae	c	Diabetes	Leaf	Cooked leaf taken
Cocos nucifera L., Z-240	Narikel	Arecaceae	t	Jaundice	Green fruits	Water is taken
				Diarrhoea	Green fruits	Water is taken
Colocasia esculenta (L.) Schott., Z-08	Kachu	Araceae	h	Iron tonic	WP	Cooked plant is taken
				Cut	Leaf	Juice is applied
Crinum asiaticum Roxb.,Z-209	Crinum	Liliaceae	h	Cow gastric	Fruits	Paste is taken
Curcuma zedoaria (Christm.) Rosc., Z-281	Shathi	Zingiberaceae	h	Diarrhoea	Rhizome	Powder is taken
Cuscuta reflexa Roxb.,Z-280	Cuscuta	Cuscutaceae	h	Jaundice	Stem	Juice is taken
Cynodon dactylon (L.) Pers., Z-158	Durba	Poaceae	h	Cut	WP	Juice is applied
				Cut and wound	Leaf	Paste is applied
Dalbergia sissoo Roxb.,Z-274	Sissue	Fabaceae	t	Jaundice	Leaf	Juice is taken
Datura metel L.,Z-273	Dutra	Solanaceae	s	Dermatitis	seed	Paste is applied
Dillenia indica L., Z- 143	Chalta	Dilleniaceae	t	Reduced pressure	Fruits	Fruit is taken
Dillenia pentagyna Roxb., *Z-242*	Harganja	Dilleniaceae	t	Fractured bone	Leaf, Bark	Paste is applied
Eclipta prostrata (L.) Mant, Z-11	Kesharaj	Asteraceae	h	Impotence	WP	Juice is taken
				Hair tonic	Wp	Juice is applied
Entada scandens auct. *non* Benth., *Z-241*	Gila	Mimosaceae	c	Rheumatic pain	Seed	Seed is taken
Erythrina indica Lamk., Z-14	Mandar	Fabaceae	t	Jaundice	Leaf, Bark	Juice is taken
Chromolaena odoratum(L.) King and Robinson , Z-272	Pisais	Asteraceae	h	Cut	Leaf	Paste is applied
Paederia foetida L. Z-272	padra pata	Rubiaceae	c	Diarrhoea	Leaf	Cooked leaf taken
Ficus benghalensis L., Z- 77	Bot	Moraceae	t	Diabetes	Fruits	Cooked fruit taken
Ficus racemosa L.,Z-271	Jogdumur	Moraceae	t	Diabetes	Fruits	Cooked leaf taken
Cyperus rotundus L., Z-168	Gandhavadlu	Cyperaceae	c	Diarrhoea	Leaf	Cooked leaf taken
Garcinia cawa Roxb. *ex* DC., Z-270	Kao	Clusiaceae	t	Appetizer	Fruits	Fruit is taken
Garcinia xanthochymous Hook. f. *ex* T. Anders, Z-269	Dayphal	Clusiaceae	t	Appetizer	Fruits	Fruit is taken

Contd.

Scientific name, Voucher number	Local name	Family	Habit	Ailments	Part used	Treatment mode
Glycosmis arborea (Roxb.) A. DC., Z-20	Awapata	Rutaceae	s	Stomach ache	Leaf	Juice is taken
				Jaundice	Leaf	Juice is taken
				Heart pain	Leaf	Juice is taken
				Head ache	Leaf	Leaf paste is applied
				Fever,	Leaf	Juice is taken
				Dysentery	Leaf	Juice is taken
				Cough	Leaf	Juice is taken
				Appetizer	Leaf	Juice is taken
				Anthlemin tic	Leaf	Juice is taken
Hibiscus sabdariffa L., Z-60	Amila	Malvaceae	h	Jaundice	Leaf	Cooked leaf is taken
Hygrophila spinosa T. Anders., Z-268	Talmakhna	Acanthace ae	h	Eye complain	Seed	Juice is applied
Hydnocarpus kurzii (King)Warb.,Z-87	Chalmugra	Archariace ae	t	Leprosy	Fruits	Oil is applied
				Dysentery	Root	Juice is taken
Hyptis suaveolens (L.) Poit., Z-267	Tokma	Lamiaceae	h	Reduced pressure	seed	Seed is taken
			h	Dysentery	Seed	Juice is taken
			h	Constipati on	seed	Seed is taken
Ipomoea fistulosa Mart. *ex* Choisy, Z-203	Khulum	Convolvul aceae	h	Cut	Latex	Latex is applied
Ipomoea mauritiana Jacq., Z-265	Bhuikumra	Convolvul aceae	c	Miscarriag e	Root	Juice is taken
Jatropha curcas L., *Z-266*	Keke	Euphorbia ceae	s	Toothache	Leaf	Juice is applied
Kalanchoe pinnata (Lamk.), Z-46	Pathorkuch	Crassulaceae	h	Urinary problem	Leaf	Juice is taken
				Dysentery	Leaf	Juice is taken
				Cough	Leaf	Juice is taken
Leucas lavandulaefolia Smith., Z-28	Dandakala sh	Lamiaceae	h	Stomach ache	Leaf	Juice is taken
				Diarrhoea	Leaf	Fried leaf is taken
				Cough	Leaf	Fried leaf is taken
Litsea glutinosa (Lour.) Robinson, Z- 94	Chengpisla	Lauraceae	t	Stomach ache	Leaf, Bark	Juice is taken
				Impotence	Leaf, Bark	Juice is taken
				Dysentery	Leaf, Bark	Juice is taken
				Constipati on	Leaf, Bark	Juice is taken
Lawsonia inermis L., Z- 35	Mehedi	Lythraceae	s	Impotence	leaf	Juice is taken
				Impotence	leaf	Juice is taken
				Hair tonic	Leaf	Paste is applied
				Gastric	Leaf	Juice is taken
				Birth control	Leaf	Juice is taken

Contd.

Scientific name, Voucher number	Local name	Family	Habit	Ailments	Part used	Treatment mode
Mangifera indica L., Z-243	Aam	Anacardiaceae	t	Toothache	Leaf	Juice is applied
				Dysentery	Leaf	Paste is taken
Melia sempervirens (L.) Sw., Z-34	Bela	Meliaceae	t	Dermatitis	Leaf	Paste is applied
Mentha arvensis L., Z-264	Pudina	Lamiaceae	h	Stomach ache	Leaf	Juice is taken
Mikania cordata (Burm. f.) B.L. Rob., Z-261	Refujeelata	Asteraceae	c	Dysentery	Leaf	Juice is taken
				Cut	Leaf	Juice is applied
Mimosa pudica L., Z-15	Chaitamara	Mimosaceae	h	Waist pain	root	Juice is taken
				Toothache	Root	Juice is applied
				Measles	Stem	Juice is applied
				Malaria	Root	Juice is taken
				Jaundice	Leaf	Juice is taken
				Fever	Leaf	Juice is taken
				Anthlemintic	Leaf	Juice is taken
				Abscess	Root	Paste is applied
				During birth	Root	Paste is applied
Acacia intisia (L.) Willd., *Z-262*	Sadachaitamara	Mimosaceae	h	Snakebite	Root	Juice is applied
				Impotence	root	Juice is taken
				Allergy	Root	Juice is taken
Moringa oleifera Lamk.,Z-252	Sajna	Moringaceae	t	Stomach ache	Fruits	Cooked fruit is taken
				Rheumatic pain	Leaf, Bark	Cooked leaf is taken
				Diarrhoea	Leaf	Juice is taken
Murraya paniculata (L.) Jack., Z-25	Kamini	Rutaceae	t	Toothache	Leaf	Juice is applied
				Toothache	Leaf	Juice is applied
Murrya koenigii (L.) Spreng., Z-254	Norshing	Rutaceae	s	Diarrhoea,	Leaf	Cooked leaf is taken
				Cough	Leaf	Cooked leaf is taken
Musa paradisiaca L, Z-253.	Kola	Musaceae	h	Dysentery	Fruits	Fruit is taken
				Cut	Peduncle	Juice is applied
				Constipation	Peduncle	Cooked peduncle is taken
Nicotiana plumbaginifolia Viv., Z-255	Tamak	Solanaceae	h	Cut	Leaf	Juice is applied
Nigella sativa L., Z-256	Kalojira	Ranunculaceae	h	Impotence	seed	Oil is taken
				Diabetes	seed	Water extract is taken
Nyctanthes arbor-tristis L., Z-257	Shephaliful	Nyctaginaceae	s	Fever	Leaf	Juice is taken

Contd.

Scientific name, Voucher number	Local name	Family	Habit	Ailments	Part used	Treatment mode
				Anthlemintic	Leaf	Juice is taken
Ocimum americanum L. Z-237	Rossetpata	Lamiaceae	h	Stomach ache	Leaf	Cooked leaf is taken
				Gastric	Leaf	Cooked leaf is taken
				Diarrhoea	Leaf	Juice is taken
				Cough	Leaf	Juice is taken
*Ocimum basilicum*L., Z-02	Kalotulsi	Lamiaceae	h	Reduced pressure	Leaf	Paste is applied
				fever	leaf	Juice is taken
				Cough	Leaf	Juice is taken
Ocimum sanctum L., Z-153	Sada tulsi	Lamiaceae	h	Reduced pressure	Leaf	Paste is applied
				Cough	Leaf	Juice is taken
				cough	Leaf	Juice is taken
Oroxylum indicum (L.) Kurz., Z-110	Kanaidingi	Bignoniaceae	t	Jaundice	Bark	Juice is applied
Oryza sativa L., Z-236	Dhan	Poaceae	H	Diarrhoea	Seed	Powder is taken
Oxalis corniculata L., Z-23	Zinzil	Oxalidaceae	h	Stomach ache	Leaf	Juice is taken
				Appetizer	Leaf	Juice is taken
Pandanus foetidus Roxb., Z--235	Keya	Pandanaceae	H	Cough	Rhizome	Juice is taken
*Phyllanthus emblica*L., Z-44	Aola	Euphorbiaceae	t	Impotence	Fruits	Fruit is taken
				Appetizer	Fruits	Fruit is taken
Piper betel L., Z- 187	Pan	Piperaceae	c	Cut	Leaf	Juice is applied
				cut	Leaf	Juice is applied
Plumbago zeylanica L., Z-261	Chita	Plumbaginaceae	h	Dermatitis	Root	Juice is applied
Cnesmone javanica Blume, Z-260	Chutra	Euphorbiaceae	h	Dermatitis	Leaf	Juice is applied
Persicaria hydropiper (L.), Spach Z-138	Bishkatali	Polygonaceae	h	Dermatitis	Leaf	Juice is applied
				Jaundice	Leaf	Juice is taken
Chylocalyx perfoliatus (L.) Hassk. *ex* Miq.L., Z- 48	Kantaamrai	Polygonaceae	h	Diabetes	Leaf	Paste is taken
				Cough	Leaf	Fried leaf is taken
*Psidium guajava*L., Z- 43	Peara	Myrtaceae	t	Toothache	Leaf	Decoction is used for gargling
				Dysentery	Leaf	Juice is taken
				Diarrhoea	Leaf	Juice is taken
Ricinus communis L., Z-258	Verenda	Euphorbiaceae	s	Constipation	Seed	Oil is taken
				Vomiting	Bark	Juice is applied
Saccharum officinarum L., Z-234	Akh	Poaceae	h	Jaundice	Stem	Juice is taken
Scoparia dulcis L., Z-16	Chinipata	Scrophulariaceae	h	Eye complain	Leaf	Juice is applied
				Diarrhoea	Leaf	Juice is taken
				Diabetes	Leaf	Juice is taken

Contd.

Scientific name, Voucher number	Local name	Family	Habit	Ailments	Part used	Treatment mode
Sesamum indicum L. Z-259	Til	Pedaliaceae	h	Eczema	Seed	Oil is applied
Smilax macrophylla Roxb., Z 233	Kumarilata	Smilacaceae	c	Impotence	Leaf	Leaf is taken internally
Solanum violaceum Ortega, Z-129	Boroibegun	Solanaceae	s	Stomach ache	Fruits	Paste is taken
Spilanthes acmella (L). L., Z- 19	Piperman	Asteraceae	h	Toothache	Flowers	Juice is applied
				Ear and mouth rot	Flowers	Juice is applied
Sterculia villosa Roxb. *ex* Smith, Z- 125	Udal	Sterculiaceae	t	Jaundice	Petiole	Juice is taken
				impotence	Petiole	Juice is taken
				Gastric	Petiole	Juice is taken
				Dysentery	Petiole	Juice is taken
				Diabetes	Petiole	Juice is taken
				Constipation	Petiole	Juice is taken
Streblus asper Lour., Z-84	Sheora	Moraceae	t	Dysentery	Leaf	Juice is taken
Swietenia mahagoni Jacq., Z-42	Mehogoni	Meliaceae	t	Diabetes	Seed	Juice is taken
Syzygium cumini (L.) Skeels, Z-39	Jam	Myrtaceae	t	Toothache	Leaf	Juice is applied
				Diabetes	Seed	Seed is taken
*Tagetes erecta*L., Z- 79	Gada	Asteraceae	h	Fire injury	leaf	juice is applied
				Cut	Leaf	Juice is applied
Tamarindus indica Willd., Z- 116	Tentul	Caesalpiniaceae	t	Sensitize	Fruits	Fruit is taken
				Reduced pressure	Fruits	Fruit is taken
				Diarrhoea	Fruits	Fruit is taken
				Appetizer	Fruits	Fruit is taken
Terminalia arjuna (Roxb. *ex* DC.) Wight & Arn., Z- 130	Arjun	Combretaceae	t	Heart pain	Bark	Juice is taken
				Gastric	Bark	Juice is taken
				Dysentery	Bark	Juice is taken
Terminalia bellirica (Gaertn.) Roxb., Z- 108	Bohera	Combretaceae	t	Stomach ache	Fruits	Fruit is taken
				Impotence	Fruits	Fruit is taken
				Dysentery	Fruits	Fruit is taken
				Appetizer	Fruits	Fruit is taken
Terminalia chebula Retz., Z- 55	Horitaki	Combretaceae	t	Stomach ache	Fruits	Fruit is taken
				Jaundice	Bark	Decoction is taken
				Impotence	Fruits	Fruit is taken
				Appetizer	Fruits	Fruit is taken
Tinospora crispa (L.) Hook. f. & Thoms, Z-232	Gulancha	Menispermaceae	c	Anthlemintic	Stem	Juice is taken
Vitex negundo L., Z- 131	Nishinda	Verbenaceae	s	cough	Leaf	Juice is taken
Vitis quadrangualris Wall. *ex* Wight & Arn., Z- 136	Harjora	Vitaceae	c	Fractured bone	Stem	Paste is applied
Zingiber officinale Rosc., Z-114	Ada	Zingiberaceae	h	Neck pain	Rhizome	Decoction is taken
Ziziphus mauritiana Lamk., Z-05	Boroi	Rhamnaceae	t	Wound	Leaf	Boiled water applied

Of 124 species documented in the study area, herbs have been represented by 43%, trees by 31%, shrubs by 15% and climbers by 11%of total species (Fig. 2). The result reflected that herbs are the most dominant life form among the medicinal plants in the study area. In order to maintain medicinal diversity in nature, herbaceous plants can be cultivated easily as a major source of crude drugs because of short life cycle. Usually people take medicines in different ways including oral application, external application and adjunct therapy. Oral application is the main mode of treatment in the study area and followed by external application (Fig. 3).

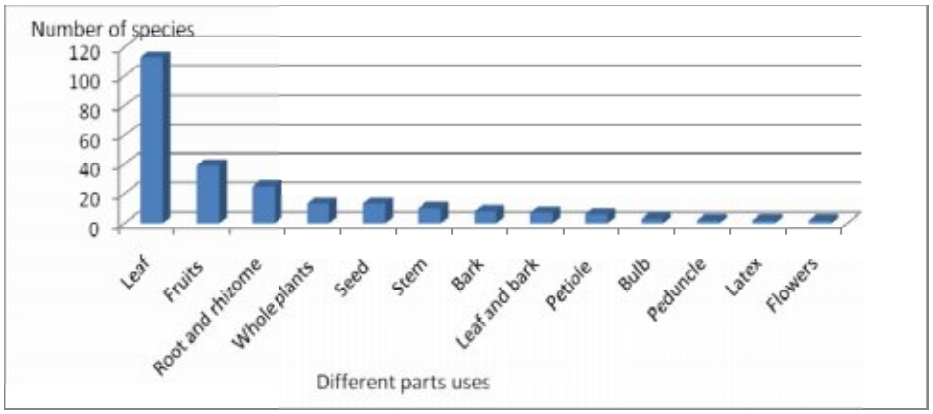


Fig. 1. Diversity in parts used of medicinal plants.

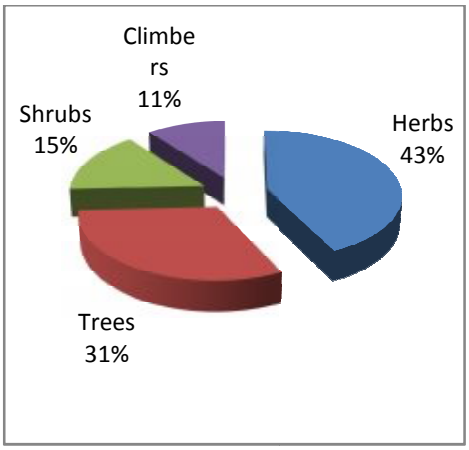


Fig. 2. Different life forms of species.

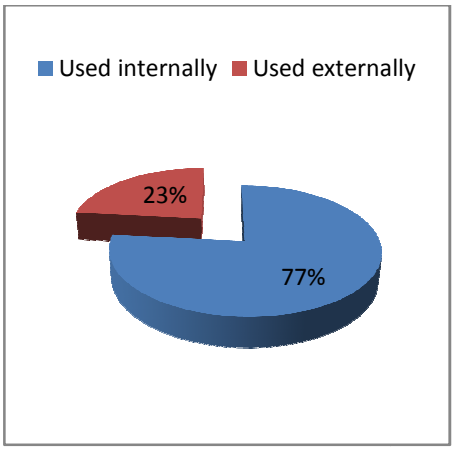


Fig. 3. Application modes of medicines.

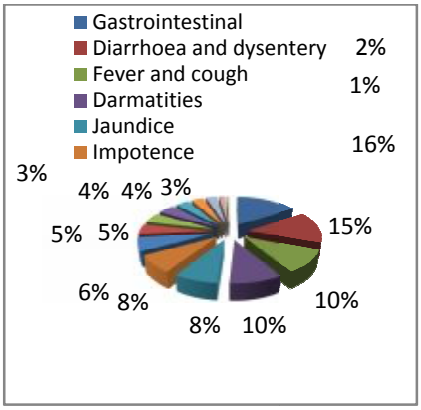


Fig. 4. Fomularies.

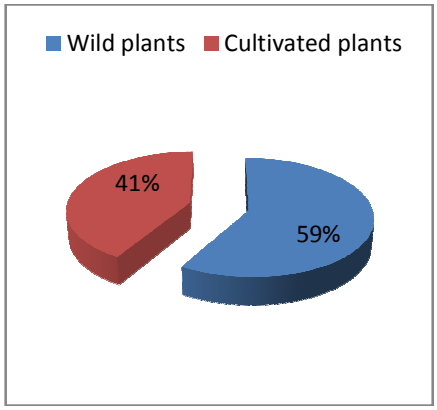


Fig. 5. Sources of medicinal plants.

Number of formularies for major ailment group showed variation. Maximum formularies were found in the six ailment groups including gastrointestinal complain, diarrhea and dysentery, fever and cough, dermatitis, jaundice and impotence (Fig. 4). It is proved that such complains are very common in the study area. According to the local people most plants (59%) were harvested from the wild vegetation and minimum (41%) harvested from cultivated plants (Fig.5). Cultivation of medicinal plants is still in low because of availability of wild vegetation in national park. It is observed in the field that harvesting of medicinal plants from the wild is not sustainable. Local people are not aware of sustainable use of medicinal plants. They like to earn some cash money for their livelihood by selling illegal plant parts from the wild. As far literature there is no appropriate policy and guide line for medicinal plants harvesting from the wild in Bangladesh. Currently some cultivation program of medicinal plants has been started here in Bangladesh. But herbal industries are yet depending on foreign supply for raw drug materials (Personal communication).

Table 2. Consensus of agreement in the uses of medicinal plants among the informants.

Major ailments group	Nur	Nt	Fic
Cut and wound	188	15	0.93
Jaundice	196	21	0.90
Respiratory related (malaria, fever and cough)	235	26	0.90
Diabetes	90	12	0.88
Diarrhoea and dysentery	258	36	0.87
Anthelmintic	50	8	0.86
Gastrointestinal complain	263	39	0.86
Impotence	118	18	0.86
Dermatitis	155	24	0.85
High blood pressure	62	12	0.82
Urinary disorder	32	7	0.81
Rheumatic pain	49	11	0.79
Toothache	34	11	0.70
Eye complain	9	4	0.63

Based on the information obtained from the informants, the recorded ailments were grouped into 14 categories (Table 2). The results could be useful in prioritizing medicinal plants for further scientific validation of plant products, as pharmacologically effective remedies with higher Fic values. Fic values range from 0.00 to 1.00. High values are obtained when only one or few plants species are reported to be used by a high proportion of informants to treat a particular ailment, whereas low Fic values indicate that the informants disagree over which plants to use. Higher Fic values can thus be used to pinpoint particularly interesting species for the search of bioactive compounds. In our analysis Fic values for major ailment categories showed variation (Table 2). The average Fic value for all ailment categories obtained was0.78. Such value indicated that maximum people in the study area were well informed about the medicinal knowledge of plants and also showed agreement on the use of medicinal plants for such categories of ailments. Top Fic values found in case of ailment cut and wound. The most cited species used to treat such ailment are *Mikania cordata, Chromolaena odoratum* and *Cynodon dactylon*. Among them *Cynodon dactylon* and *Chromolaena odoratum* showed maximum Fl values.These species can be used for further phytochemical analysis to find active compounds for treatment of cut and wound. Jaundice and respiratory related (malaria, fever, cold and cough) treatment scored second highest Fic values. Most cited species to treat such categories of ailmentwere *Ceriscoides campanulata, Oroxylum indicum, Cuscuta reflexa, Averrhoa carambola, Citrus aurantifolia, Cajanus cajan, Ocimum sanctum, Andrographis paniculata, Ocimum basilicum and Justicia adhatoda* . Such species can be used for further phytochemical analysis to find active compounds for the treatment of Jaundice and respiratory related ailments.

Fidelity level is useful for identifying the key informants most preferred species used for treating certain ailments. The medicinal plants that are widely used by the local people have higher FL values than those that are less used. On the other hand, medicinal plants that are known as remedies of a single aliment have 100% fidelity level than those that are used as remedies for more than one type of aliment. In our analysis Fl values showed variations. Among the most cited species 9 scored Fl values of 100%. The maximum Fl for plants indicated 100% choice of informants for treating specific ailments. Such species are *Chromolaena odoratum, Ceriscoides campanulata, Oroxylum indicum, Cuscuta reflexa, Averrhoa carambola, Cajanus cajan, Justicia adhatoda* and *Citrus aurantifolia.* These are cultural bounded species and indicated their healing potential.

Table 3. Fidelity level (Fl) values of the frequently reported plants and their major uses.

Scientific name	Ailments	Number of informants (Ip)	Total informants (Iu)	Fidelity level (%)
Chromolaena odoratum	Cut and wound	32	32	100
Ceriscoides campanulata	Jaundice	28	28	100
Oroxylum indicum	Jaundice	27	27	100
Cuscuta reflexa	Jaundice	25	25	100
Averrhoa carambola	Jaundice	22	22	100
Cajanus cajan	Jaundice	21	21	100
Justicia adhatoda	cough	20	20	100
Citrus aurantifolia	Jaundice	20	20	100
Cynodon dactylon	Cut and wound	37	37	100
Syzygium cumini	Diabetes	25	26	96.15
Mikania cordata	Cut and wound	58	61	95.08
Ocimum sanctum	Cough	53	60	88.33
Ocimum basilicum	Cough	30	34	88.24
Litsea glutinosa	Dysentery	64	79	81.01
Andrographis paniculata	Malaria	34	50	68
Clerodendrum viscosum	Stomach ache	30	48	62.5
Terminalia arjuna	Heart pain	44	81	54.32
Centella asiatica	Dysentery	40	76	52.63
Azadirahta indica	Dermatitis	50	115	43.48
Sterculia villosa	impotence,	27	68	39.71
Terminalia arjuna	Dysentery	20	81	24.69
Azadirahta indica	Anthlemintic	20	115	17.39

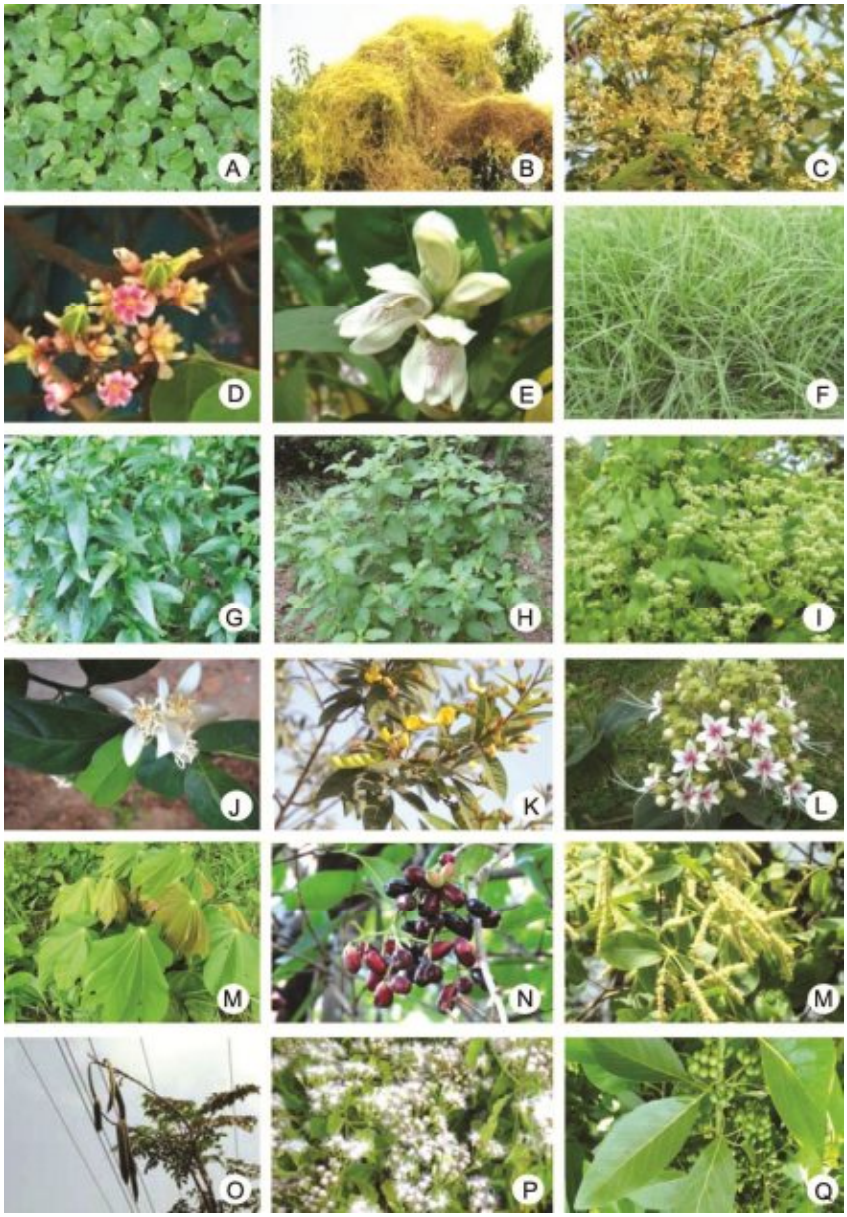


Plate 1. Images of most cited medicinal plants by the local people in the study area: *a. Centella asiatica,* b. *Cuscuta reflexa,* c. *Azadirachta indica,* d. *Averrhoa carambola,* e. *Justicia adhatoda* , f. *Cynodon dactylon,* g. *Andrographis paniculata,* h. *Ocimum sanctum,* i. *Mikania cordata,* j. *Citrus aurantifolia,* k. *Cajanus cajan,* l. *Clerodendrum viscosum,* m. *Sterculia villosa,* n. *Syzygium cumini,* o. *Terminalia arjuna,* p. *Oroxylum indicum,* q. *Chromolaena odoratum,* r. *Litsea glutinosa.*

PRK values varied from species to species as indicated in the Table 4. *Litsea glutinosa* scored top PRK value indicating very popular plant species in the study area and used for diarrhoea, dysentery and impotence. *Mikania cordata, Ocimum sanctum, Azadirachta indica, Terminalia arjuna, Centella asiatica, Andrographis paniculata* and *Cynodon dactylon* were also most cited species in the study area. These species are also well known medicinal plants in our country. The present analysis also confirmed their popularity among the local people of Lawachara national park. High PRK data of medicinal plants is the indication for further ethno-lead drug research to find active new drugs.

Table 4. Citation frequency of most cited medicinal plants.

Scientific name	Family	Ailments	Citation no.	Percentage of Respondents Knowledge (PRK%)
Litsea glutinosa	Lauraceae	Dysentery	64	39.26
Mikania cordata	Asteraceae	Cut and wound	58	35.58
Ocimum sanctum	Lamiaceae	Cough	53	32.52
Azadirachta indica	Meliacae	Dermatities	50	30.67
Terminalia arjuna	Caesalpiniacae	Heart pain	44	26.99
Centella asiatica	Clusiaceae	Dysentery	40	24.54
Andrographis paniculata	Acanthaceae	Malaria	34	20.86
Cynodon dactylon	Poaceae	Cut and wound	34	20.86
Chromolaena odoratum	Asteraceae	Cut wound	32	19.63
Clerodendrum viscosum	Verbenaceae	Stomach ache	30	18.40
Ocimum basilicum	Lamiaceae	Cough	30	18.40
Ceriscoides campanulata	Rubiaceae	Jaundice	28	17.18
Oroxylum indicum	Bignoniaceae	Jaundice	27	16.56
Sterculia villosa	Sterculiaceae	impotence,	27	16.56
Cuscuta reflexa	Cuscutaceae	Jaundice	25	15.34
Syzygium cumini	Myrtaceae	Diabetes	25	15.34
Averrhoa carambola	Averrhoaceae	Jaundice	22	13.50
Cajanus cajan	Fabaceae	Jaundice	21	12.88
Justicia adhatoda	Acanthaceae	cough	20	12.27
Azadirachta indica	Meliaceae	Anthlemintic	20	12.27
Citrus aurantifolia	Rutaceae	Jaundice	20	12.27
Terminalia arjuna	Combretaceae	Dysentery	20	12.27

Observations in the field, interviews and discussions with local people, a good number of threats to medicinal plants have been identified. The most serious threats are exotic timber species plantation in and around national park, fallow lands, homesteads, roadsides and even in the edges cultivated lands. *Acacia auriculiformis, Acacia mangium, Eucalyptus camadulensis, Dalbergia sissoo, Laeucaena leucocephala, Swietenia mahagoni and Cassia siamea* are most preferred plant species for plantation. According

to local people perception such species are very selfish plants and they do not support native species under their canopy. Illegal logging and over exploitation from the national park vegetation are other threats to medicinal plants in the study area. Lack of awareness among the local people about impact of exotics on native plants and environment is another threat to medicinal plants. Availability of the modern medicines which promotes the negligence of use of herbal medicines among the local people in the study area is also threats to medicinal plants. Senior people with herbal knowledge do not like to share their knowledge with juniors. Due to sudden death of such people, herbal knowledge of the area lost forever.

A list of conservation measures is made based on present survey results and observations. Distribution map of all culturally important medicinal plant species in the study area could be made. Population status of such species across the habitats could be determined. Current rate of exploitation by local people could be calculated. If it seems that medicinal plants are vulnerable in the natural habitats, necessary measures could be taken for *ex situ* conservation. Awareness programs among the local influential persons who can make change could be created.

The present endeavor in and around Lawachara national park is very preliminary. It would be better if we could take more interviews with local people in the study area. Due to budget and time constrains, the present study is not well enough to draw sound conclusion. It needs further long term survey to further validate all ethnomedically important data for ethno-lead drug exploration research. In future, joint research in ethnobotany with pharmacognosy and phytochemistry are essential to confirm traditional knowledge of medicinal plants. The present quantitative evaluation of ethnobotanical data from in and around Lawachara national park probably is the first effort. The data indicated that the study area has plenty of medicinal plants (124 species) and diversity health care uses (53 ailments with 244 formularies) of such plants. Using modern mathematical tools Fic values on the uses of medicinal plants have been determined. The average Fic value for all ailment categories obtained 0.78. Such value indicated that maximum people in the study area were well informed about the medicinal knowledge of plants and also showed agreement on the use of medicinal plants for such categories of ailments. Maximum Fic values (more than 0.80) obtained in case of Cut and wound, Jaundice, Respiratory related ailments, Diabetes, Diarrhoea and dysentery, Anthelmintic, Gastrointestinal complain, Impotence, Dermatitis and High blood pressure. *Chromolaena odoratum, Ceriscoides campanulata, Oroxylum indicum, Cuscuta reflexa, Averrhoa carambola, Cajanus cajan, Justicia adhatoda* and *Citrus aurantifolia* showed 100% Fl values. *Litsea glutinosa, Mikania cordata, Ocimum sanctum* and *Azadirahta indica* were scored maximum PRK value. It is recommended that species showed high Fic, Fl and PRK values could be used for further ethno-lead phytochemical analysis to find active compounds to discover drugs from plants. As the medicinal plants and traditional knowledge in and around the park are in threatened condition, appropriate measures should be taken for sustainable conservation. For the community development, resource conservation, primary health care and economic growth such plants and knowledge can play an important role.

Acknowledgements

The authors acknowledge the University Grants Commission (UGC) Bangladesh for partial financial aid for the research. The authors are also thankful to informants in the data collection process during the field works in and around Lawachara National Park. Cooperation from Local range office of Lawachara National Park is also acknowledged.

References

Ahmad, N. 1970. Working plan for the forests of the Sylhet division for the period 1963-64 to 1982-83, Working plan division 2, CTG.E.P. Dacca, East Pakistan Govt. Press, pp. 1-22.

Ahmed, Z.U., M.A. Hassan, Z.N.T. Begum, M. Khondker, S.M.H. Kabir, M. Ahmad, A.T.A. Ahmed, A.K.A. Rahman and E.U. Haque, (Eds.) 2008a. *Encyclopedia of Flora and Fauna of Bangladesh, Vol. **6**. Angiosperms: Dicotyledons (Acanthaceae – Asteraceae).* Asiatic Society of Bangladesh, Dhaka. pp. 1-408.

Ahmed, Z.U., M.A. Hassan, Z.N.T. Begum, M. Khondker, S.M.H. Kabir, M. Ahmad, A.T.A. Ahmed, A.K.A. Rahman and E.U. Haque, (Eds) 2008b. *Encyclopedia of Flora and Fauna of Bangladesh, Vol. **12**. Angiosperms: Monocotyledons (Orchidaceae – Zingiberaceae).* Asiatic Society of Bangladesh, Dhaka. pp. 1-552.

Ahmed, Z.U., M.A. Hassan, Z.N.T. Begum, M. Khondker, S.M.H. Kabir, M. Ahmad, A.T.A. Ahmed, A.K.A. Rahman and E.U. Haque,(Eds.) 2009b. *Encyclopedia of Flora and Fauna of Bangladesh, Vol. **7**. Angiosperms: Dicotyledons (Balsaminaceae – Euphorbiaceae).* Asiatic Society of Bangladesh, Dhaka. pp. 1-546.

Ahmed, Z.U., M.A. Hassan, Z.N.T. Begum, M. Khondker, S.M.H. Kabir, M. Ahmad, A.T.A. Ahmed,A.K.A. Rahman and E.U. Haque,(Eds.) 2009c. *Encyclopedia of Flora and Fauna of Bangladesh, Vol. **8**. Angiosperms: Dicotyledons (Fabaceae–Lythraceae).* Asiatic Society of Bangladesh, Dhaka. pp. 1-478.

Ahmed, Z.U., M.A. Hassan, Z.N.T. Begum, M.Khondker, S.M.H. Kabir, M. Ahmad and A.T.A. Ahmed,(Eds.) 2009d. *Encyclopedia of Flora and Fauna of Bangladesh, Vol. **9**. Angiosperms: Dicotyledons (Magnoliaceae–Punicaceae).* Asiatic Society of Bangladesh, Dhaka. pp. 1-488.

Ahmed, Z.U., M.A. Hassan, Z.N.T. Begum, M. Khondker, S.M.H. Kabir, M. Ahmad and A.T.A. Ahmed, (Eds.) 2009e.*Encyclopedia of Flora and Fauna of Bangladesh, Vol. **10**. Angiosperms: Dicotyledons (Ranunculaceae –Zygophyllaceae).* Asiatic Society of Bangladesh, Dhaka. pp. 1-580.

Ahsan, M.F. 2000. Socio-Ecology of the Hoolock Gibbon *(Hylobates hoolock)* in Two Forests of Bangladesh. Field Research: 284-299.

Ahsan, M.M. 2007. Perceptions of tourism by indigenous communities living in and adjoining Lawachara National Park. *In*: Fox, J., Bushley, B.R, Dutt, S and Quazi, S.A. (eds.). Making conservation work: linking rural livelihoods and protected areas management in Bangladesh. East-West Centre and Nishorgo Program of the Bangladesh Forest department. pp. 131-148.

Alam, M. K. 1988. Annotated checklist of the woody flora of Sylhet forests. Bull. **5**. Plant Taxonomy Series. Bangladesh Forest Research Institute, Chittagong. 153 pp.

Alam, M.K. 1992. Medical ethno-botany of the Marma tribe of Bangladesh. Economic Botany **46**(3): 330-330.

Alam, M.K. 1998. Documentation of Ethnobiological Information. *In*: Banik, R.L., Alam, M.K., Peil, S. and Rastogi, A. (eds). Applied Ethnobotany. Bangladesh Forest Research Institute: Chittagong. pp. 28-29

Alam, M.K., J.U. Choudhury and M.A. Hassan, 1996. Some folk formularies from Bangladesh. *Bangladesh J. Life Sci.* **8**(1): 49-63.

Alexiades, M.N. (ed.) 1996.*Selected Guidelines for Ethno botanical Research: A Field Manual*.

The New York Botanical Garden, New York. 1-306 pp.
Borris, R P. 1999. Natural products research: perspectives from a major pharmaceutical company. *J Ethnopharmacol*.**51**:29–38.
Breevot, P. 1998. The booming of US botanical market: A new overview of herbal gram. **44**: 33-46.
Canonizado, J.A. and S.M. Rahman, 1998. GOB/WB Forest resources management project technical assistance component: integrated forest management plan for the Sylhet forest division. Mandala Agricultural Development Corporation and Forest Department, Ministry of Environment and Forest, Dhaka, Bangladesh, pp. 1-4.
Chambers, R. 1994. Participatory Rural Appraisal (PRA): Analysis of experience. World Development **22**(9): 1253-1268.
Friedman, J., Z. Yaniv, A. Dafni, and D. Palewitch, 1986. A preliminary classification of healing potential plants, based on a rational analysis of an ethno pharmacological field survey among Bedouins in the Negev Desert, Israel. *Journal of ethno pharmacology*. **16**: 275-287.
Green, 1990. IUCN Directory of South Asian protected areas. IUCN The World Conservation Union, Gland, Switzerland and Cambridge, UK, pp. 24-30.
Haque, T., M.Z. Uddin, M.L. Saha, M.A. Mazid and M.A. Hassan, 2014. Propagation, antibacterial activity and phytochemical properties of *Litsea glutinosa* (Lour.) C. B. Rob. *Dhaka Univ. J. Biol. Sci.* **23**(2): 165-171.
Hassan, M.A. and M.S. Khan, 1986. Ethnobotanical record of Bangladesh-1: Plants used for healing fractured bones. *J. Asiatic Soc. Bangladesh.* (Sci.).**12**(1&2): 33-39.
Hassan, M.A. and M.S. Khan, 1996. Ethnobotanical record of Bangladesh-2. Plants used for healing cuts and wounds. *Bangladesh J. Plant Taxon.* **3**(2): 49-52.
Heinrich, M., A. Ankli, B. Frei, and C. Weimann, 1998. Medicinal plants in Mexico: healers consensus and cultural importance. *Social Science and Medicine* **47**: 1859–1871.
Hooker, J.D. 1872-1897. Flora of British India **1-7**. First Indian Reprint 1973 Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
Hyland, B.P.M. 1972. A technique for collecting botanical specimens in rain forest. Flora Malesiana Bulletin. **26**: 2038-2040.
Khan, I., N.M. Abdelsalam,. H. Fouad, A. Tariq, R. Ullah and M. Adnan, 2014. Evident-Based complementary and alternative medicine: Article ID 635371, p.21 Hindwai.
Khan, M.S., M.A.Hassan and M.Z. Uddin, 2002.Ethnobotanical survey in Rema-Kalenga Wildlife Sanctuary (Habiganj) in Bangladesh. *Bangladesh J. Plant Taxon.* **9**(1): 51-60.
Martin, G.J. 1995. *Ethnobotany: A Methods Manual.* Chapman & Hall, London. 1-268 pp.
Mia, M.M.K. and A.M. Huq, 1988. A preliminary ethno-botanical survey in the Jointiapur, Tamabil and Jafflong area, Sylhet, Bangladesh National Herbarium Bull. **3**: 1-10.
Moerman, D.E. 1996. An analysis of the food plants and drug plants of native North America. *J. Ethnopharmacol.* **52**:1–22.
Prain, D. 1903. Bengal Plants Vol. **1-2:** 1-1013pp. First Indian Reprint 1963, Bishen Singh Mahendra Pal Singh Dehra Dun.
Riadh, S.M. 2007. Assessing the role of non-timber forest products in the livelihoods of communities living inside and outside of Lawachara National Park. *In*: Fox, J., Bushley, B.R, Dutt, S. and Quazi, S.A. (eds.). Making conservation work: linking rural livelihoods and protected areas management in Bangladesh. East-West Centre and Nishorgo Program of the Bangladesh Forest department. pp. 36-49.
Rizvi, S.N.H. 1970. East Pakistan District Gazetteers for Sylhet. Government of East Pakistan Services and General Administration Department, Dhaka, pp. 5-6.
Schultes, R E. 1978. The kingdom of plants. In: Thomson W A R, editor. Medicines from the Earth. New York, N.Y: McGraw-Hill Book Co.; p. 208.
Setzer, M.S., J.S. Werka, A.K. Irvine, B.R. Jackes and W.N. Setzer, 2006. Biological activity of rain forest plant extracts from far north Queensland, Australia. In: Williams L.A.D. (ed.).

Biologically active natural products for 21st century. Trivandrum, India: Research Signpost: p 21-46.

Siddiqui, K.U., M.A. Islam, Z.U. Ahmed, Z.N.T. Begum, M.A. Hassan, M. Khondker, M.M. Rahman, S.M.H. Kabir, M.Ahmad, A.T.A.Ahmed, A.K.A. RahmanandE.U.Haque, (Eds) 2007c. *Encyclopedia of Flora and Fauna of Bangladesh, Vol.**11**. Angiosperms: Monocotyledons (Agavaceae-Najadaceae)*. Asiatic Society of Bangladesh, Dhaka. pp.1-399.

Stevens, P.R. 1986. Land classification and soil suitability for plantation in Sylhet division. Working Paper No. 26 (UNDP/FAO) Project BGD/79/017, 21 pp.

Trotter, R.T. and M.H. Logan, 1986. Informant census: A new approach for identifying potentially effective medicinal plants. Page 91-112 *in* L.N. Etkin, ed., Plants in indigenous medicine and diet. Redgrave, Bedford Hill, New York.

Uddin, M.Z and M.A Hassan, 2014. Determination of informant consensus factor of ethnomedicinal plants used in kalenga forest, Bangladesh. *Bangladesh j. plant taxon.* **21**(1): 83-91.

Uddin, M.Z. and M.A. Hassan, 2004. Flora of Rema-Kalenga Wildlife Sanctuary. IUCN Bangladesh Country Office, Dhaka, Bangladesh, vi+120pp.

Uddin, M.Z., M.A. Hassan, M.M. Rahman, and M.K. Arefin, 2012.Ethno-medico-botanical study in Lawachara National Park, Bangladesh. *Bangladesh J. Bot.***41**(1): 97-104.

Uddin, M.Z. and S. Roy, 2007. Collection and Management of Selected Medicinal Plants in Rema-Kalenga Wildlife Sanctuary.*In*: Making Conservation Work: Linking rural livelihoods and protected area management in Bangladesh edited by Fox, J. Bushley, B. R., Dutta S. and Quazi, S. A. 2007. Monograph of East-West Center, Hawaii, USA: 66-83pp.

Uddin, M.Z. S. Roy, M.A. Hassan and M.M. Rahman, 2008. Medicobotanical report on the Chakma people of Bangladesh. *Bangladesh J. Plant Taxon.***15** (1): 67-72

Uddin, M.Z., M.A. Hassan and M. Sultana, 2006. Ethnobotanical survey of medicinal plants in Phulbari Upazila of Dinajpur District, Bangladesh. *Bangladesh J. Plant Taxon*. **12**(1): 63-68.

Uddin, M.Z., M.S. Khan and M.A. Hassan, 2001. Ethno medical plants records of Kalenga forest range (Habiganj), Bangladesh for malaria, jaundice, diarrhoea and dysentery. *Bangladesh J. Plant Taxon*. **8**(1): 101-104.

Uddin, S.N. 2006. Traditional uses of ethnomedicinal plants of the Chittagong Hill Tracts. Bangladesh National Herbarium, Dhaka. 879p.

Uddin, S.N., M.Z. Uddin, M.A. Hassan and M.M. Rahman, 2004.Preliminary ethno-medical plant survey in Khagrachari district, Bangladesh. *Bangladesh J. Plant Taxon*. **11**(2): 39-48.

http://www.usaid.gov/bd/files/NSPManagement_Plans_for_LNP.pdf

Wright, C.W. 2005. Plant derived antibacterial agents: new leads and challenges, *Phytochemistry Reviews.* **4** (1): pp. 55-61.

USAID, 2006. Management Plans for Lawachara National Park. International Resources Group (IRG), Connecticut, Washington. 207 pp.

Yusuf, M., M.A. Rahman, J.U. Choudhury and J. Begum, 2002.Indigenous knowledge about the use of Zingibers in *Bangladesh. J. Econ. Taxon. Bot.* **26**(3): 566-570.

Yusuf, M., M.A. Wahab, J.U. Choudhury and J. Begum, 2006. Ethno-medico-botanical knowledge from Kaulkhali proper and Betunia of Rangamati district. *Bangladesh J. Plant Taxon.* **13**(1): 55-61.

(Revised copy received on 28/5/2017)